ECON 102
Spring 2014
Homework 3
Due March 26, 2014

1. For this problem, you need to download data about the country Badgerstan from the website:
   https://mywebspace.wisc.edu/mmorey/web/102Data.xls

   The file includes various data related to GDP over the 20th century. The data includes measures of the aggregate economy measured in 2000 dollars. Use the data in the rest of the calculations.

   a) What is the GDP of Badgerstan in each year over the period 1991-2000?
   b) Calculate the growth rate of GDP from each year to the next (i.e. 1900 to 1901, 1901 to 1902… 1999 to 2000). During which year was the growth rate of GDP the highest?
   c) What is the average annual growth rate of consumption (hint: average of the 50 year-to-year growth rates of consumption) over the first half of the century? Second half of the century? Which one is higher?
   d) Suppose that, beginning in 2000, the following changes occur:
      i. consumption grows at 5% each year
      ii. investment grows at 10% each year
      iii. government spending immediately increases to $1000 and then remains constant
      iv. exports increase by 2% each year
      v. imports increase by 2% each year

      Given these changes, what will be the values of GDP over the years 2001-2010?

a)

1991	47,118,163.96
1992	51,829,628.97
1993	57,012,215.44
1994	62,713,052.62
1995	68,983,973.67
1996	75,881,965.73

1997	83,469,701.80
1998	91,816,219.17
1999	100,997,375.90
2000	111,096,612.41

b) Growth in GDP from 1949 to 1950 was 14.983%

c) 1901-1950 average consumption growth = 15% > 1951-2000 growth = 10%

d)

2001	116652387.5
2002	122485473.4
2003	128610265.2
2004	135041353.4
2005	141794058.4
2006	148884467.5
2007	156329472.6
2008	164146811.2
2009	172355108.2
2010	180973920.6

2. The Econ 102 TAs decide to throw a party for their students. Emily buys $200 worth of Sicilian-style pizza from a local pizza shop. Moheb buys Brazilian mate tea that is worth $150 but he paid $175 because it is certified as “free trade.” Zach bought $350 of pasta but he saved $50 of the pasta for his own consumption next year. Xun grew $100 worth of apples in her orchard and brought them and gave them away to the students. Pedro bought $300 of soda, although he didn’t realize that the sodas were expired because they were bottled last year. Mitch brought no food but instead taught a lesson that the students thought was so valuable that the students together would have paid $500.

How much does the TA party contribute to US GDP this year?

Pizza is produced in America: +$200 Consumption

Mate is imported: +$175 Consumption, -$175 Imports

Pasta is consumed and invested/inventory: +$300 Consumption, $50 Investment

Apples are consumed: +$100

Sodas are consumed out of inventory (they were produced in a prior year): +$300 Consumption, -$300 (dis)Investment

Knowledge is consumed by students: +$500

Total: $1150

3. When Hawaii was a territory of the United States, the only production outside of the home in Hawaii occurred in the sugar industry, coconut industry, and pineapple industry. In 1920, there were 300 workers: 75 sugar cane cutters, 125 coconut tree climbers, and 100 pineapple pickers. The wages for those workers in 1920 were $1000 per year per worker. There were machines used to cut down sugar cane that were leased for $2500 per year per machine. In 1920 4 machines were used. No machinery was used to collect coconuts or pick pineapples. In 1920, the sugar company made profits of $4000, the coconut company made profits of $2500, and the pineapple company made profits of $5000. Assume there were no other factor costs of production.

Given this information, what was the GDP of Hawaii in 1920?

wages = 300*$1000 = $300,000

interest = 0

rent = 4*$2500 = $10,000

profits = $4000 + $2500 + $5000 = $11500

GDP = $300,000 + $0 + $10,000 + $11,500 = $321,500

Note: Problem 4 is taken from the following website:
http://economics.about.com/cs/interestrates/a/real_interest.htm

4. Use the following data in the table to answer the questions:

Year	CPI	Nominal Interest Rate
2011	100	---
2012	110	15%
2013	120	13%
2014	115	8%

a) What is the real interest rate for year 2012, 2013 and 2014?

Notation
i: is the Inflation Rate
n: is the Nominal Interest Rate
r: is the Real Interest Rate

To calculate the real interest rate, we need to know the inflation rate (or expected inflation rate, if we're making a prediction about the future). From the data given we don't have the inflation rate, but we can calculate it from the CPI data:

Calculating the Inflation Rate

We need to use the following formula:

i = {[CPI(this year) – CPI(last year)] / CPI(last year)}*(100%).

So the inflation rate in year 2012 is [110 – 100]/100 = .1 = 10%. We do this for all three years and get the following:

Inflation Rate Data
Year 2011: --
Year 2012: 10.0%

Year 2013: 9.1%
Year 2014: -4.2%

Now we can calculate the real interest rate. The relationship between the inflation rate and the nominal and real interest rates is given by the expression: (1+r)=(1+n)/(1+i). However for low levels of inflation we can use the much simpler Fisher Equation to calculate the real interest rate:

FISHER EQUATION: r = n – i

Using this simple formula, we can calculate the real interest rate for years 2012 through 2014:

Real Interest Rate (r = n – i)
Year 2011: --
Year 2012: 15% - 10.0% = 5.0%
Year 2013: 13% - 9.1% = 3.9%
Year 2014: 8% - (-4.2%) = 12.2%

So the real interest rate is 5% in year 2012, 3.9% in year 2013, and 12.2% in year 2014.

b) Suppose you are offered the following deal: you lend $200 to a friend at the beginning of year 2012 and charge him/her the nominal interest rate of 15% and he/she pays you back $230 at the end of year 2012. If you agree to this deal will you be made better or worse off?

You wanted to know if you should lend $200 to your friend at the beginning of year 2. If you do make that loan, you will earn a real interest rate of 5%. Since 5% of $200 is $10, you will be financially ahead by making the deal. It doesn't necessarily mean that you should make the deal. There is no right choice to this problem: it depends on how much you value consumption (or happiness) today relative to consumption one year from now (Economists refer to this as a person's discount factor).

Note: Problem 5 is taken from the following website:
http://www-personal.umich.edu/~alandear/courses/102/homework/hw01-07.pdf

5. Imagine an economy in which only one good – Tasty Ice Cream – is produced and consumed. Each 1/2 gallon carton of ice cream costs $5. Your last job paid you $200.

   Now you want to reap the benefits of your hard labor.

   You have two options: you can either indulge in ice cream right away, and because you are an ice cream fanatic you can't stop before you've used up all

your money. Or you can just hold off with the purchases for one more year and receive 12% interest on your bank deposits in the meantime. Assume there is no discount factor (you are indifferent between consuming ice cream this year or one year after)

a) The nominal return on your saving in this example is 12%: you get 12% more money back than what you deposited originally. How many extra dollars will you have available to spend after one year? Also, calculate the number of extra cartons of ice cream you will be able to buy if the price remains constant at $5 per carton. What is the percentage increase in the number of gallons of ice cream you are able to consume (real rate of return)?

If you consume now you can have 40 cartons of ice cream ($200/$5), or equivalently 20 gallons. If you put your money in the bank you will have $224 ($200 x 1.12) at the end of a year, i.e. you'll receive $24 for waiting for one year. This means that you could buy 44.8 cartons of ice cream ($224/$5) if their price remained at $5 a carton, which is means you can consume 2.4 more gallons (4.8/2) compared to indulging today. So your return in terms of ice cream gallons (real return) is equal to 12% ((22.4 - 20)/20).

Now suppose that global warming increases the cost of refrigeration, so over the course of the year Tasty Ice Cream becomes more expensive: The price per carton rises to $5.60.

b) Now what is your real return from saving your money for one year rather than consuming it right away? How many extra gallons of ice cream do you get to purchase after one year of waiting? What, in this case, is the percentage increase in the number of gallons of ice cream you will be able to consume?

Since the nominal interest rate is unchanged, your nominal return from saving your money for one year is still 12%. However, the $224 that you can withdraw from your bank account after one year cannot buy as much ice cream as before, because ice cream has become more expensive. You can only buy 40 cartons of ice cream ($224/$5.6), equivalently 20 gallons, at the price of $5.60 per carton. This is the same amount of ice cream you could have bought without saving. So your real return in terms of ice cream is equal to 0 % ((20-20)/20). Because prices have risen, your real return is now less than your nominal return.

The above calculations show that the real rate of return (r) on your savings (i.e. the real rate of interest) is just the nominal rate (i) adjusted for changes in price (i.e. inflation, π).

c) Use your calculations to verify the following approximation of the real rate of interest: $r \approx i - \pi$. (Caveat: this approximation works only when both the inflation rate and the nominal interest rate are small.) Here r is the real rate of interest, i is the nominal rate of interest, and π is the inflation rate.

The nominal rate of interest, i, is just the percentage return you get from the bank, 12%=0.12. The rate of inflation is the percentage by which prices rise in one year, in this case the price only of Tasty Ice Cream, since it is the only good: ($5.60-$5.00)/$5.00 = 0.12 = 12%. The formula therefore gives:

r =0 .12 -0 .12 = 0

This turns out to be exactly equal to the value of 0% found above using the actual price of ice cream.

d) Which interest rate – nominal or real – matters for your decision whether to consume today or tomorrow? Give a brief explanation. In your own case, would you rather consume now or wait?

What matters for your decision whether to consume today or in a year is obviously the real interest rate, as it tells you how much you'll really get in return for your patience. However, some of us may prefer to consume their ice cream today, and some of us prefer to wait for another year. That depends on our personal preferences. More generally, the higher the real interest rate, the more you are rewarded for saving, which means that saving will be increasing in the real interest rate. In other words, the higher the real interest rate, the more costly it is to consume today, since you will have to forego more consumption later – therefore, consumption is decreasing in the real interest rate. When the real interest rate is zero, there is no incentive to defer consumption, and hence no reason to save.

Note: Problem 6 is taken from the following website:
http://mysite.avemaria.edu/gmartinez/Courses/ECON201/pdf/Nicaragua/HWansCh08b.pdf

6. Evaluate as accurately as you can how each of the following individuals would be affected by unanticipated inflation of 10 percent per year.

a) A pensioned railroad worker, assuming the pensioned railway workers have no other income and that the pension is not indexed against inflation.
b) A heavily indebted farmer.
c) A retired business executive whose current income comes entirely from interest on government bonds.
d) The owner of an independent small-town department store.

(a) The retired worker's real income would decrease every year by approximately 10 percent of its former value.

(b) If the inflation is also in the price the farmer gets for his products, he could gain. But more likely the price increase are mostly in what he buys, since farm machinery, fertilizer, etc. tend to be sold by less competitive sellers with more power to raise their prices. The farmer faces lots of competition and has to rely on the market price to go up- the farmer has little control over prices on an individual basis. Moreover, if interest rates on the farmer's new debts have gone up with the process, the farmer could be even worse off. The other side of the coin is that if no new borrowing is necessary, the inflation will reduce the real burden of the farmer's debt, because the purchasing power declines on the fixed payment he contracted to make before inflation.

(c) The retired executive is in the same boat as the pensioned railroad worker, except that the executive's income from the bonds or other interest bearing assets is probably greater than the railroad worker's income from the pension. The increase in inflation has most probably been accompanied by rising interest rates, with a proportional drop in the price of bonds. Therefore the retired executive would suffer a capital loss if he or she decided to cash in some of the bonds at this time and the fixed interest received on these existing bonds is worth less in terms of purchasing power. In other words, the executive, although wealthier than the retired worker, may be affected just as much or more from inflation.

(d) Assuming the storeowner's prices and revenues have been keeping pace with inflation, his or her real income will not change unless the costs have risen more than the product prices.

Note: Problem 7 is taken from the following website:
http://www-personal.umich.edu/~alandear/courses/102/homework/hw01-07.pdf

7. The GDP Deflator and the Consumer Price Index

Price indices are very important in macroeconomics. We use them to measure inflation and adjust for its effects. This problem is designed to help us calculate and understand price indices.

There are many price indices. One is the Consumer Price Index (CPI), commonly reported in the news. The CPI calculates the cost of a certain basket of consumer goods and services each month. The change in the cost of this basket is the basis for computing the increase in the cost of living.

Another price index of interest in macroeconomics is the GDP Deflator, which is used to calculate real (i.e. deflated) GDP. While a fixed basket of goods and services is used in calculating the CPI, the GDP deflator is measured using the set of final goods and services that is actually produced in the economy in a given time period.

Suppose the economy of Ann Arbor produces 4 goods, but only strawberries, ice cream, and sushi are consumer goods. Coolers are also final goods, but are not bought by consumers. Assume that for the purposes of constructing the CPI, that the level of consumption in 2000 of strawberries, ice cream and sushi is set as the market basket. The total production of all goods is given in the following table followed by their prices:

Quantities				
Item	2000	2001	2002	2003
Strawberries	8	9	9	10
Ice Cream	10	14	18	20
Sushi	12	12	12	15
Coolers	-	-	2	8
Prices				
Item	2000	2001	2002	2003
Strawberries	$4	$5	$5	$6
Ice Cream	$2	$2	$3	$5
Sushi	$3	$3	$4	$5
Coolers	-	-	$8	$4

Using these data, answer the following questions:

a) Using the CPI as the price index, what are the inflation rates between 2000 and 2001, 2001 and 2002, 2002 and 2003? For the CPI assume that you are using a 100 point scale. Show your work in arriving at your final answer.

Step 1: Take 2000 as the base year, and take consumption in 2000 as the basket for constructing the CPI. Calculate the cost of the consumption basket for years 2000 through 2003.

Cost of basket of goods in 2000: 8 x 4 + 10 x 2 + 12 x 3 = $88

Cost of basket of goods in 2001: 8 x 5 + 10 x 2 + 12 x 3 = $96

Cost of basket of goods in 2002: 8 x 5 + 10 x 3 + 12 x 4 = $118

Cost of basket of goods in 2003: 8 x 6 + 10 x 5 + 12 x 5 = $158

Step 2: Calculate the CPI for each year.

CPI2000 = 100

CPI2001 = (96/88) x 100 = 109.1

CPI2002 = (118/88) x 100 = 134.1

CPI2003 = (158/88) x 100 = 179.5

Step 3: Calculate the rate of inflation based on the CPI for all years

Inflation rate 2000-2001 = (CPI2001-CPI2000)/CPI2000 = (109.1 - 100.0) / 100.0 = 9.1%

Inflation rate 2001-2002 = (CPI2002-CPI2001)/CPI2001 = (134.1 - 109.1) / 109.1 = 22.9%

Inflation rate 2002-2003 = (CPI2003-CPI2002)/CPI2002 = (179.5 - 134.1) / 134.1 = 33.9%

b) Calculate the rate of inflation based on the GDP deflator for all years. Use 2000 as the base year in your calculations and assume that you are using a 100 point scale. Show how you arrived at your answers.

Step 1: Compute the nominal GDP for each year.

Nominal GDP2000 = 8 x 4 + 10 x 2 + 12 x 3 = $ 88

Nominal GDP2001 = 9 x 5 + 14 x 2 + 12 x 3 = $109

Nominal GDP2002 = 9 x 5 + 18 x 3 + 12 x 4 + 2 x 8 = $163

Nominal GDP2003 = 10 x 6 + 20 x 5 + 12 x 5 + 8 x 4 = $267

Step 2: Compute the real GDP for each year using 2000 prices. For coolers, take the price in 2002 as its base year price.

Real GDP2000 = 8 x 4 + 10 x 2 + 12 x 3 = $ 88

Real GDP2001 = 9 x 4 + 14 x 2 + 12 x 3 = $100

Real GDP2002 = 9 x 4 + 18 x 2 + 12 x 3 + 2 x 8 = $124

Real GDP2003 = 10 x 4 + 20 x 2 + 12 x 3 + 8 x 8 = $189

Step 3: Compute GDP deflators for all years.

GDP deflator 2000 = (Nominal GDP2000 / Real GDP2000) x 100 = 100

GDP deflator 2001 = (Nominal GDP2001 / Real GDP2001) x 100 = 109 / 100 x 100 = 109.0

GDP deflator 2002 = (Nominal GDP2002 / Real GDP2002) x 100 = 163 / 124 x 100 = 131.5

GDP deflator 2003 = (Nominal GDP2003 / Real GDP2003) x 100 = 267 / 189 x 100 = 141.3

Step 4: Calculate the rate of inflation based on the GDP deflator for all years.

Inflation rate 2000-2001 = (GDPdeflator2001 - GDPdeflator2000) / GDPdeflator2000 =

(109.0 – 100.0) / 100.0 = 9.0%

Inflation rate 2001-2002 = (GDPdeflator2002 - GDPdeflator2001) / GDPdeflator2001 =

(131.5 – 109.0) / 109.0 = 20.6%

Inflation rate 2002-2003 = (GDPdeflator2003 - GDPdeflator2002) / GDPdeflator2002 =

(141.3 – 131.5 / 131.5 = 7.5%

c) Compare the inflation rates you've calculated based on the CPI and the GDP deflator. How do you explain the differences? Hint: the availability of coolers improves the quality of ice cream. In this example, can you detect other reasons as to why the CPI overstates inflation?

All inflation rates measured by the percentage change in the GDP deflator are smaller than the inflation rates measured by the percentage change in the CPI. This is primarily because the CPI assumes a fixed basket.

From 2000 to 2001, there is an increase in the price of strawberries, but the prices of the other consumption goods remain the same, which makes strawberries relatively more expensive. As a result, we observe substitution away from strawberries. In other words, consumption of strawberries would have increased even more, had its price not increased.

Instead, consumers switched into other goods, in this example into ice cream. The GDP deflator takes this into account, but not the CPI.

From 2001 to 2002, the quality of ice cream has increased due to the availability of coolers. The increase in price of ice cream is not just due to inflation, but it also reflects this increase in quality. The CPI fails to take this into account, as it measures the old quantity and quality of ice cream, whereas the GDP deflator accounts for the new units of ice cream in 2002.

From 2002 to 2003, the price of coolers, the new good, has dropped dramatically, and its share in GDP has increased a lot. The CPI does not capture this decrease in price, as it does not include coolers for two reasons: coolers were not available in the base year of the CPI and coolers are not consumption goods.

This exercise demonstrates that the CPI does tend to overstate inflation in practice, yet it is a better measure of the cost of living than the GDP deflator.

d) The following table gives the aggregate nominal income of middle class citizens in this country. In which year did they have the highest well-being? To answer this question you will need to use the CPI you calculated in (a).

2000	2001	2002	2003
$110	$115	$145	$190

In order to find well being we need to convert all income levels to some year's constant dollars. Below we are converting nominal incomes to real income based on year 2000 prices.

2000 dollar value of 2000 income = $110

2000 dollar value of 2001 income = 2001 nominal income x CPI2000 / CPI2001 = 115 x 100 /109.1 = $105.4

2000 dollar value of 2002 income = 2002 nominal income x CPI2000 / CPI2002 = 145 x 100 / 134.1 = $108.1

2000 dollar value of 2003 income = 2003 nominal income x CPI2003 / CPI2000 = 190 x 100 / 179.5 = $105.8

Middle class citizens' well being was the highest in 2000.

Alternatively, you can calculate how many consumption good baskets a middle class citizen could afford in each year.

2000 income/2000 cost of consumption basket = $110 / $88 = 1.25

2001 income/2001 cost of consumption basket = $115 / $96 = 1.20

2002 income/2002 cost of consumption basket = $145 / $118 = 1.23

2003 income/2003 cost of consumption basket = $190 / $158 = 1.20

A middle class citizen could afford to consume most in the year 2000.

8. **Price Indices and New Products-** People in a certain economy value two things: function and style. Products are bundles that give individuals different amounts of function and style. In years 1 and 2, there are two products which are creatively branded as product X and product Y. In year 3, a new product is created, product Z. The following table lists the prices of the goods in each of the three years, followed by how much function and style the good provides:

	Year 1 Price	Year 2 Price	Year 3 Price	Function	Style
X	$2/unit of X	$5/unit of X	$3/unit of X	10	9
Y	$4/unit of Y	$5/unit of Y	$4/unit of Y	12	9
Z			$2/unit of Z	12	14

(a) If the market basket for this economy is originally 1 unit of X and 2 units of Y, what is the value, measured in dollars, of the market basket in year 1? What is the value of the same basket in year 2? If year 1 is defined to be the base year, what is the CPI in year 2 (the CPI in year 1 will be 100)? What is the inflation rate between years 1 and 2? (Hint: You will not need the "function" and "style" columns to find these answers.)

To find the value of the market basket in each of the years, you simply compute how much it would cost to buy the basket in that year.

*Value in year 1 = 2 (price of good X) + 2*4(price of good Y) = $10.*

*Value in year 2 = 5 (price of good X) + 2*5 (price of good Y) = $15.*

To compute the CPI in a given year, you take the ratio of the value of the market basket in the year to the value of the market basket in a base year and multiply it by 100.

CPI in year 1 = 100.

CPI in year 2 = (15/10) * 100 = 150.

Inflation = Percentage change in CPI = (150-100) / 100 = 50%.

(b) A problem with using CPI to measure the "average" price is that it is defined in terms of goods. So, when a new product is introduced, it is difficult to decide how much of that product should be included in the "market basket" for the economy. For example, good Z above causes problems when trying to compute inflation between years 2 and 3. What if the BLS (Bureau of Labor Statistics) took the following approach: instead of tracking the change in price of the goods, they tracked the change in price of the different characteristics of the good? Say, instead, they defined the market basket as a certain amount of function and style. What function and style basket would be equivalent to the basket from part (a)?

Function = 10 (from good X) + 2*12 (from good Y) = 34.
Style = 9 (from good X) + 2*9 (from good Y) = 27.

(c) If you can only consume discrete (1,2,3...) amounts of each good, what is the least amount a consumer can spend to get at least the function and style basket in part (b) in the years 1, 2, and 3.

In year 1, 2X costs the same as 1Y and provides more function and style, so the cheapest way to get function and style is to only buy X. So, **the price of the function and style basket is 4*2 (Price of X) = 8.**

In year 2, Y provides more function and the same amount of style as good X and it costs the same, so buy only enough Y. It takes 3 Y to get 36 function and 27 style, so **the price of the function and style basket in year 2 is 15.**

In year 3, Z is introduced. Z is cheaper and provides more function and style than product X and product Y, so the cheapest way to get function and style is to

purchase Z. **The price of the function and style basket in year 3 is 3*2 (Price of Z) = 6.**

(d) Now, take the values computed in (c) as the value of the market basket in years 1, 2, and 3. Calculate the inflation rate between years 1 and 2, and the rate between years 2 and 3.

Inflation rate between years 1 and 2 = (Value of basket in 2 – Value of basket in 1) / Value of basket in 1 = (15 – 8) / 8 = 7 / 8 = 0.875 = 87.5%.

Inflation rate between years 2 and 3 = (Value of basket in 3 – Value of basket in 2) / Value of basket in 2 = (6 – 15) / 15 = -9 / 15 = -3 / 5 = -0.6 = -60%.

(e) Did the inflation rate calculated in part (a) over or under-state inflation from years 1 to 2 as measured in (d)? Calculate the CPI from years 2 to 3 by using the same market basket as in part (a) (2 units of Y and 1 unit of X) and the same base year (year 1). Does the inflation rate between years 2 to 3 calculated using the "goods"-based CPI over or understate the inflation rate calculated in part (d)?

The inflation rate calculated in part (a) was 50%, but when valuing the underlying attributes of the good, we see that inflation was even higher: 87.5%.
Value of market basket in year 3 = 3 (price of good X) + 2*4 (price of good Y) = 11. So, CPI in year 3 = (11/10)*100 = 110. Then, we can calculate inflation as:

(CPI in year 3 – CPI in year 2) / CPI in year 2 = (110-150) / 150 = -40 / 150 = -4 / 15 = 0.27-ish, so we have a deflation rate of about 27%.

If we use the attributes-based price index we have a deflation rate of 60%! So, the deflation rate is higher (or: the inflation rate is lower) with the attributes-based price index.